



## The cost analysis of varicose vein treatment techniques in Turkey: a benefit or profit problem?

Cost analysis of varicose vein treatment

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### Abstract

**Aim:** Varicose veins are common healthcare problem in Turkey and worldwide. In this study, we compared the economic parameters of commonly used varicose treatment techniques, particularly classical surgical techniques, endovenous radiofrequency ablation (RFA) and glue (cyanoacrylate) techniques' costs, hospital bills, and profits. **Material and Method:** A total of 100 patients who had varicose vein operations, were evaluated retrospectively between April 2017 and November 2017. These patients were divided into subgroups depending on the methods used such as classical surgical treatment or catheter-based techniques. Demographic data including age, gender, hospitalization period, cost of the patient, amounts billed to SGK, and the patient-based profit/loss was analyzed for groups of varicose vein treatments described above. **Results:** Twenty-nine patients (29%) were treated by surgery and 71 patients (71%) received catheter-based treatments. Thirty-four patients (34%) were treated by glue injection, and 37 patients (37%) were treated by RFA. There was no difference between the groups for the length of hospital stay ( $p > 0.05$ ). The glue group had the highest cost ( $2093.8 \pm 148.9$  TL) while the surgery group had the lowest cost ( $618.2 \pm 365.4$  TL), with the RF group in between ( $1453.1 \pm 130.3$ ) ( $p < 0.001$ ). The RF group had the highest profit for the hospital ( $209.9 \pm 261.3$  TL), while the glue group had the lowest profit ( $-66.3 \pm 126.2$  TL) ( $p < 0.001$ ). **Discussion:** The most suitable strategy seems to be RFA when profit is a concern. But the patient's wishes, anatomical properties, activity/working conditions and the physician's choice for the welfare of the patient should be determinative.

### Keywords

Venous Insufficiency; Radiofrequency Ablation; Varicose Vein Surgery; Cyanoacrylate, Cost.

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**Introduction**

Varicose veins are defined as dilated tortuous superficial veins, which are at least 3 mm in diameter, resulting in vein enlargement and pooling of the blood. Varicose veins cause symptoms ranging from simple discomfort, to swelling and ulceration of the legs. It usually affects the great saphenous vein (GSV) or the small saphenous vein (SSV), or deep veins as a consequence of valvar insufficiency in the veins. In the literature, a wide range of therapeutic options is proven to be effective in treating varicose veins, including medical therapy, compression stockings, classical surgical techniques, and evolving minimally invasive techniques such as thermal ablation or chemical ablation of the vein with venous insufficiency. The choice of technique has changed over the time due to the preferences of the physicians and patients, or due to the marketing pressure that we may not be aware of. Each percutaneous technique necessitates the use of different catheters, thermal devices, or chemical materials which can increase costs for the hospitals, and by extension, the budget of the health care system in Turkey. There have been a number of studies on the cost-effectiveness of these treatment modalities in foreign countries, primarily England and Canada. Unfortunately, to date there has been no such comparison of the cost of these techniques in Turkey. In this study, we compare the economic parameters of commonly used varicose treatment techniques, particularly classical surgical techniques, endovenous RFA, and glue (cyanoacrylate) techniques' costs, hospital bills, and profits.

**Material and Method**

A total of 100 patients who had varicose veins operated on in our clinic, were evaluated retrospectively between April 2017 and November 2017. The study protocol was approved by our faculty's Local Ethics Committee (March 2<sup>nd</sup>. 2018). A written informed consent was obtained from each patient before treatment. The study was conducted in accordance with the principles of the Declaration of Helsinki.

One hundred most recent patients were selected and then divided into subgroups depending on the methods used, such as classical surgical treatment or catheter-based techniques. Patients receiving catheter-based techniques were further divided into two major subgroups; receiving RFA and glue treatments. The number of patients considered was limited because of the frequently changing bill payment system due to Health Practice Service, or "Sağlık Uygulama Tebliği (SUT)" in Turkish. All patients' hospitalization period, cost to the hospital, bills to the Social Security Institution (SSI) ("Sosyal Güvenlik Kurumu" (SGK) in Turkish), and the profit/loss for the hospital were evaluated by using hospital bills obtained from our hospital's Department of Accounting. Since SUT does not pay extra for the first control within the first 10 days after the operation, all the costs of the patients within the first control were also added to the cost. Demographic data including age, gender, hospitalization period, cost of the patient, amounts billed to SGK, and the patient-based profit/loss was analyzed for groups of varicose vein treatments described above.

Statistical analysis was performed using SPSS 20.0. Some of the data were evaluated using descriptive statistical tests. Since the parameters follow a normal distribution, comparison

between the groups was tested using T-test and OneWay ANOVA. A Tukey test was also used to evaluate the data for the two groups. For categorical parameters, comparison of the groups was analyzed using Pearson's Chi-Square test. Results are statistically significant if  $p < 0.05$  with a 95% confidence interval.

**Results**

A total of 100 patients were taken into either surgery or catheter-based techniques for treatment of varicose veins, or venous insufficiency. Twenty-nine patients (29%) were treated by varicose vein surgery and 71 patients (71%) received catheter-based treatments. Thirty-four patients (34%) were treated by glue injection, and 37 patients (37%) were treated by RFA. Overall, 65 of the patients were female (65%), and 35 were male (35%). The mean age for female patients was  $48.77 \pm 11.88$ , while the mean age was  $45.26 \pm 13.08$  for male patients. Statistically, there was no difference between the age groups ( $p = 0.18$ ). Furthermore, in a binary comparison of all three groups, there was also no statistically significant difference between the groups ( $p > 0.05$ ). Demographic data for the patients are presented in Table 1.

Table 1. Demographic data of the patients treated for varicose veins/venous insufficiency. (F: Female; M: Male; N: Number of patients; RFA: Radiofrequency ablation, SD: Standard deviation)

Group (Total N=100)	N	Gender		Age (Mean $\pm$ SD) (years)
		M	F	
Surgery	29	12	17	46.48 $\pm$ 8.04
Glue	34	8	26	49.65 $\pm$ 13.72
RFA	37	15	22	46.43 $\pm$ 13.83

Of the 29 patients in the surgery group, 13 patients (44.8%) had either ligation of GSV or SSV, nine patients (31.0%) had unilateral GSV stripping, and one patient (3.4%) had bilateral GSV stripping. Three patients (10.3%) had combined GSV stripping with SSV ligation. Three patients (10.3%) had perforating vein surgery. All but four of the patients had concomitant mini-phlebectomy during the surgical procedure. In the surgery group, 20 patients (70.0%) received general anesthesia (one patient with laryngeal mask), and seven patients (24.1%) received local anesthesia (for GSV and SSV ligation). Two patients (6.9%) were operated on using spinal blockade.

For the 34 patients in the glue group, GSV catheterization was performed over the medial aspect of the knee region using Doppler ultrasonography. After catheterization, a microcatheter was inserted in the GSV about 1-2 cm proximal to the saphenofemoral junction (SFJ). By compressing the ultrasonography probe, N-butyl cyanoacrylate (Biolas VariClose®, FG Group, Turkey) was injected inside the GSV without application of tumescent anesthesia. None of the patients had mini-phlebectomy. In the glue group, 28 patients (82.4%) were operated on under local anesthesia, whereas 5 patients (14.7%) received general anesthesia (2 by a laryngeal mask) and 1 patient (2.9%) was operated on under sedation.

For the 37 patients in the RF group, GSV catheterization was performed over the medial aspect of the knee region using Doppler ultrasonography. After catheterization, an RF catheter (ClosureFast, Covidien, Mansfield, Mass) was inserted in

the GSV about 1-2 cm proximal to the SFJ). Next, tumescent anesthesia was performed around the GSV and ablation was performed. Twenty-one patients (56.8%) had RF ablation of the GSV with mini-phlebectomy and 3 of these patients had bilateral RF ablation. Twelve patients (32.4%) only had RF ablation (2 had bilateral RF ablation) and 4 patients (10.8%) had concomitant unilateral RF ablation of the GSV and ligation of the SSV with mini-phlebectomy. In the RF group, 31 patients (83.8%) received general anesthesia (10 by a laryngeal mask), whereas 3 (8.1%) had only sedation. Two of the patients (5.4%) were operated on by spinal blockade and one patient (2.7%) received local anesthesia.

All of the local anesthesia patients were discharged from the hospital on the same day as the treatment. Patients that had general anesthesia or spinal blockade were discharged either on the same day, or the following day depending on the patient's clinical status. There was no difference between the groups for the length of hospital stay ( $p > 0.05$ ).

A cost – bill and profit analysis were performed for the groups. In the surgery group, the mean cost per patient was  $618.2 \pm 365.4$  TL. The amount billed to SGK was  $626.6 \pm 326.3$  TL and the profit of the hospital was  $7.8 \pm 134.5$  TL. In the glue group, the mean cost per patient was  $2093.8 \pm 148.9$  TL. The amount billed to SGK was  $2027.5 \pm 41.4$  TL and the hospital had a loss of  $66.3 \pm 126.2$  TL. In the RF group, the mean cost per patient was  $1453.1 \pm 130.3$  TL. The amount billed to SGK was  $1672.5 \pm 290.5$  TL and the profit of the hospital was  $209.9 \pm 261.3$  TL.

Using the cost-bill and profit analysis, we observed statistically significant differences between the groups. In the cost analysis, the glue group had the highest cost while the surgery group had the lowest cost, with the RF group in between. These results were statistically significant ( $p < 0.001$ ). For the bill analysis, the glue group had the highest amount billed to SGK, whereas the surgery had the lowest amount billed ( $p < 0.001$ ). Finally, the RF group had the highest profit for the hospital, while the glue group had the lowest profit (in fact, this group had a loss,  $p < 0.001$ ). The economic data is shown in Table 2.

In the Tukey-test analysis of the groups, all groups had statistically significant differences in both cost and billings ( $p < 0.001$ ). For the profit-loss analysis, the surgery-RF groups and glue-RF groups had significant differences ( $p < 0.001$ ). In contrast, the difference for the surgery-glue group was not statistically significant ( $p = 0.274$ ). Table 3 provides the results of the statistical analysis of the groups.

**Discussion**

Varicose veins are defined as dilated tortuous superficial veins, which are at least 3 mm in diameter. They usually affect the GSV or SSV of the lower limbs. When the disease progresses, it may also affect the deep venous system. It usually causes symptoms such as discomfort, pain, and swelling of the extremity. If left untreated, varicose veins may progress to chronic insufficiency, leading to venous ulcers as a result

of increased venous pressure and tissue damage. All of these problems result in decreased quality of life (QoL), a loss of work days, and increased healthcare costs [1].

Varicose veins are common healthcare problem in Turkey and worldwide. Approximately 10-40% of Western populations have varicose veins [2]. The disease progresses by age; thus, age is the most important risk factor [3]. The symptomatic C2-3 disease is more commonly seen in the female population [4]. A family history of varicose veins and obesity are also potential risk factors [5].

There are different options for treatment of chronic venous insufficiency, including simple compression stockings, classical surgical techniques, and thermal/chemical ablation of the incompetent vein. Catheter-based techniques have increasingly replaced classical surgical techniques over the past ten years. Decisions about the treatment model should be made according to patient's CEAP classification, personal features, and economic status [6]. The 2015 Clinical Practice Guidelines of the European Society for Vascular Surgery (ESVS) recommends endovenous thermal ablation techniques as the first line treatment for GSV insufficiency in preference to both surgery and foam sclerotherapy (Class I recommendation, Level of evidence A) [7].

First published in 2008, "National Treatment Guidelines of Peripheral Artery and Vein Diseases" was revised in 2016. The most important change was probably the treatment strate-

Table 2. Economical data showing cost of the patient to the hospital, billing amount to SGK and profit-loss of the hospital. (RF: Radiofrequency ablation, SD: Standard deviation, TL: Turkish Lira)

Group	Cost (Mean ± SD) (TL)	Bill (Mean ± SD) (TL)	Profit (Mean ± SD) (TL)
Surgery	618.2 ± 365.4	626.6 ± 326.3	7.8 ± 134.5
Glue	2093.8 ± 148.9	2027.5 ± 41.4	- 66.3 ± 126.2
RFA	1453.1 ± 130.3	1672.5 ± 290.5	209.9 ± 261.3

Table 3. The Tukey test analysis of groups for cost, billing and profit/loss.

Dependent variable	Multiple Comparisons Tukey HSD		Mean Difference (I-.I)	Std. Error	Sig.	95% Confidence Interval	
	(I) Method	(.I) Method				Lower Bound	Upper Bound
Cost	Surgery	Glue	-1475,568*	57,84720	,000	-1613,2570	-1337,8778
		RF	-834,9277*	56,75742	,000	-970,0229	-699,8325
	Glue	Surgery	1475,5679*	57,84720	,000	1337,8788	1613,2570
		RF	640,64023*	54,36750	,000	511,2336	770,0469
	RF	Surgery	834,92767*	56,75742	,000	699,8325	970,0229
		RF	-640,6402*	54,36750	,000	-770,0469	-511,2336
Bill	Surgery	Glue	-1400,905*	63,26063	,000	-1551,4794	-1250,3308
		RF	-1045,912*	62,06886	,000	-1193,6495	-898,1742
	Glue	Surgery	1400,9051*	63,26063	,000	1250,3308	1551,4784
		RF	354,99323*	59,45529	,000	213,4765	496,5100
	RF	Surgery	1045,9119*	62,06886	,000	898,1742	1193,6495
		Glue	-354,9932*	59,45529	,000	-496,5100	-213,4765
Profit/Loss	Surgery	Glue	74,12833	47,95127	,000	-40,0063	188,2630
		RF	-202,0376*	47,04792	,000	-314,0220	-90,0531
	Glue	Surgery	-74,12833	47,95127	,274	-188,2630	40,0063
		RF	-276,1659*	45,06685	,000	-383,4350	-168,8969
	RF	Surgery	202,03760*	47,04792	,274	90,0531	314,0220
		Glue	276,16592*	45,06685	,000	168,8969	383,4358

\*. The mean difference is significant at the 0.05 level.

gies for chronic venous insufficiency. The National Guidelines strongly recommends cyanoacrylate glue, endovenous laser, and RF techniques for treatment of GSV insufficiency. Surgical treatment was the first line therapy in 2008. In 2016's Guidelines, surgical treatment is the choice of treatment only if necessary conditions could not be provided (very strong recommendation) [6].

Any medical equipment used in the market has both advantages and potential disadvantages. The cost of catheter-based techniques adds a certain amount of burden to the economy. This subject is more important for economically underdeveloped countries. Factors influencing the cost of treatment options are quite different and include patient-dependent factors, the cost of the medical equipment, and the cost of the operating theatre and hospital. These factors are summarized in Table 4.

Table 4. Factors affecting the cost of treatment in chronic venous insufficiency.

Patient-derived factors	<ul style="list-style-type: none"> <li>· Cost of the patient if left untreated (venous ulcer etc.)</li> <li>· Cost due to loss of manpower (during or after treatment)</li> <li>· Increased number of patients (increased demand on treatment)</li> </ul>
Medical equipment	<ul style="list-style-type: none"> <li>· Cost of catheter-based techniques</li> </ul>
Hospital / OR	<ul style="list-style-type: none"> <li>· Need of anesthesia (Local, general anesthesia.)</li> <li>· Hospital length of stay</li> </ul>
Need of extra equipment	<ul style="list-style-type: none"> <li>· Need of Doppler ultrasonography in the OR</li> </ul>

The cost to the patient can be ignored in state and university hospitals in Turkey since patients do not pay extra charges for any of the given treatment options. On the other hand, the cost of catheter-based techniques to hospitals and SGK are too high. In this study, we've found that the lowest cost was for surgery, and highest for glue (618.2 vs 2093.8 TL). Although patients in the glue group were generally discharged on the same day as the operation and generally took local anesthesia, the hospital lost almost 66.3 TL per patient. The highest profit (209.9 TL per patient) was obtained from the RF operations. There was no statistically significant difference between hospital's profit/loss for the surgery and glue groups.

In comparison with the last few years, patients demand for catheter-based techniques has significantly increased. As physicians, we should select the optimal treatment method according to a patient's needs and anatomical factors. For example, interventional techniques may be suitable for an active man who needs to return to his working life as soon as possible or for an old lady to avoid the need for general anesthesia. Who would really want to do surgery on a woman with a body mass index of 35? Which 25-year-old woman would be happy with an inguinal skin incision?

Unfortunately, there have been no studies on cost-effectiveness of these techniques in Turkey. This is the first cost-profit study comparing classical surgery with catheter-based techniques. In a study of patients in England, Marsden et al. found that all interventional treatments (surgery, endothermal ablation and foam sclerotherapy) for varicose veins were cost-effective compared with compression therapy [8]. This study also found that endothermal ablation was cost-effective compared to surgery and foam sclerotherapy.

There are also studies in the literature that review the efficacy of cyanoacrylate, but none of these studies was designed to evaluate the cost-effectiveness of treatments of venous insufficiency. In a prospective randomized study comparing cyanoacrylate glue and laser ablation, cyanoacrylate was recommended as a safe, simple method which could be used as an effective endovenous ablation technique [9]. This method is quick and does not involve tumescent anesthesia, compression stockings, paresthesia, burns, marks, or pigmentation [10].

In the VeClose Trial, cyanoacrylate ablation was compared with RFA. In this non-inferiority trial, the three-month occlusion rate was 99.5% for cyanoacrylate and 96% for RFA. The QoL measurements with VCSS and AVVQ scores were comparable [11]. One of the largest meta-analysis of the clinical and cost-effectiveness of minimally invasive techniques were performed by Carroll et al., and included 34 randomized clinical trials [12]. The minimally invasive techniques reported clinical outcomes similar to surgery. Rates of recurrence were slightly lower for endovenous laser ablation, RFA and foam sclerotherapy. Higher QoL scores were reported for all evaluated interventions than for stripping. Since the differences between treatments were negligible in terms of clinical outcomes, they suggested the lowest cost technique to be the most cost-effective. In this report, total initial costs were 1155 £ for stripping, 2769 £ for RFA and 2472 £ for EVLA. In comparison, our study found that the average cost for surgery was 117 £ and 275 £ for RFA (1 £ = 5.29 TL). Although it was not considered in the literature, our cost of cyanoacrylate glue ablation was only 395 £.

With the advances in science and technology, and increasing expectations for a better, shorter and more successful method of treatment of venous insufficiency, a search has been initiated over the past decade. Ablation of GSV with non-tumescent, non-thermal cyanoacrylate glue seems to be the closest to the ideal with documented results of the longest which lasted for two years [13].

This study is the first cost analysis for Turkey. Limitations of the study include lack of data on the QoL assessment. In this study, we did not include these parameters, since we mainly focused on the economic parameters. This study, unfortunately, showed us that university hospitals and government hospitals are in a great problem with SGK, when the money-back is the concern. SGK and the government should revise their politics in health-care system not to make university hospitals economically damaged. A cost-effectiveness analysis should be the goal of the next analysis with larger set of patients, and hopefully without economical loss.

The value of a physician's knowledge, skill and labor decrease day-by-day. In cost-effectiveness studies, one of the most important factors affecting the cost is the physician. Unfortunately, physicians have no role in the cost in our country even as the cost of a catheter. If a hospital has to spend money for a certain disease, the technique with the cheaper cost options should be chosen. Among these three varicose vein treatment options, the most suitable strategy seems to be RFA when profit is a concern. But the patient's wishes, anatomical properties, activity/working conditions and the physician's choice for the welfare of the patient should be determinative. Profit concerns should never outweigh the benefit of the patient.

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**Scientific Responsibility Statement**

*The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.*

**Animal and human rights statement**

*All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.*

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